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An Exploration of Cognition and Personality Through the Lens of Cognitive Style

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Abstract

This study reappraises cognitive style at the intersection of cognitive development and personality. Traditionally conceptualised as a bipolar continuum contrasting significantly different modes of information processing, cognitive style has often been aligned with personality traits ranging from conscientiousness to openness. Our review, supported by correlational evidence, challenges this duality. Results show that openness is positively associated with nonlinear thinking, while conscientiousness is potentially unrelated to linearity, the latter is related to psychological climate. Moreover, linear and nonlinear measures are positively correlated, suggesting additive rather than opposing processes. When considering Kirton's cognitive style bipolar framework, originality is aligned with both nonlinearity and openness, while linearity is unrelated to conformity. Drawing on Piaget's theory, we distinguish the concrete stage, which supports learned, socially adaptive, and linear behaviour, from the formal stage, which enables additively both linear reasoning and nonlinear abstraction. Because fewer than half of adults reach formal cognition, many remain limited to linear thought. A similar position exists with the bipolar configuration, where a normal distribution shows half of the population limited to adaptive (linear) reasoning. These findings indicate that linearity relates to a socially shaped mode of information processing, whereas nonlinearity corresponds with, or is even replaced by, openness. This reconceptualization highlights how education's emphasis on linear learning may constrain problem-solving, leadership, and the developmental potential of an individual.

Keywords: Incremental/radical Creativity, Personality, Linear/nonlinear Cognition

Introduction

Numerous frameworks exist for categorising individual differences, such as values (Roccas et al., 2002) and motives (Winter et al., 1998). However, this paper focuses on relevant issues in the domains of personality and cognition, particularly their interaction as understood through the lens of cognitive style. Traditionally, personality and cognition have been treated as distinct domains; cognition concerns patterns of thinking, while personality concerns patten

ns of behaviour. However, these domains are interrelated in that thinking precedes behaviour. In early development of the individual, cognitive processes help shape personality, and developing personality traits, in turn, influence cognitive functioning (Brown, 2007).

For cognitive style in organisations, linearity offers predictability and control, while nonlinearity highlights the dynamic, unstable, and often unpredictable nature of real-world systems. A balanced understanding of both domains, by recognising the strengths and limitations of each, provides a more comprehensive approach to creativity, structure, and strategy in complex domains such as organisations. (Stacey, 1995)

Background of the Study

Cognition, following Piaget (1950), involves the acquisition and application of knowledge and understanding through experience, thought, and the senses. It is generally considered a learned capability, what a person can do. Here, the focus is on how different modes of the thought process affect the characteristics of knowledge and outcomes (i.e., drawing logical inferences from information, choosing among alternatives, monitoring and regulating one's own thinking).

Common underlying features of cognition include:

- *Information processing*: Conversion and storage of experiential information
- *Experience-driven development*: Reliance on prior knowledge and memory
- *Attention and control*: Regulation of thought and focus
- *Adaptation and flexibility*: Enabling learning from adjusting to environmental changes

In contrast, personality refers to enduring patterns of emotions and behaviours that distinguish between individuals. It is typically considered a stable, inherited, or persistent predisposition for interacting with the world. Prominent models include the Five-Factor Model (Costa & McCrae, 1992) and Jungian archetypes (Jung, 1923). Though these models differ in origin, the former derived from lexical factor analysis (Goldberg, 1990; Tupes & Christal, 1992), the latter rooted in psychotherapy, they show meaningful convergence (McCrae & Costa, 1989).

Research Questions

How do the stylistic variables linearity and nonlinearity relate to the dimensions of:

1. Personality (Costa & McCrae, 1992)
2. Cognitive development (Piaget, 1950)
3. Cognitive style (Kirton, 1976, 2011)

Research Objectives

To determine the relationship of linear and nonlinear thinking with selected personality variables of the Big 5 and culturally based organisational variables.

Significance of the Study

This study aims to further contribute to the existing literature by re-evaluating the concept of cognitive style. Various key insights are offered regarding how linear and nonlinear thinking can play a role as independent and additive modes of information processing. By exploring the relationships and the differentiation of linear and nonlinear thinking styles, this study addresses important theoretical gaps and provides practical implications for researchers, educators, and practitioners. The findings of this study enhance the understanding of the way people think, lead, and create by challenging the traditional bipolar models of cognitive style.

Literature Review

While cognition and personality follow different developmental trajectories, cognitive abilities emerging in structured stages (Piaget, 1950) and personality unfolding more fluidly (Costa & McCrae, 1992), their interaction plays a crucial role in shaping the style used for information processing.

A central distinction in understanding cognitive style is between level and style (Kirton, 1976, 2011):

- Level refers to capacity, the extent or how far an ability has developed, implying a quantitative, hierarchical dimension.
- Style refers to a mode, how a task is approached, emphasising qualitative differences in functioning (i.e., different modes of thinking when processing information).

These distinctions are typically orthogonal and can be found in domains such as art (Hogan et al., 2018), dance (Clements et al., 2018), and management (Berlow et al., 2021; Kirton, 1961; Salton, 1996). However, research on cognitive style often relies on a number of different dichotomous constructs rather than a common integrated framework. A recurring dichotomy is the tendency to preserve and refine existing paradigms versus the motivation to challenge and diverge from them (T. S. Kuhn, 2012) a distinction central to cognitive style. In practice, the field uses overlapping dichotomies to describe cognitive styles, many framed as semantic opposites, others as bipolar dimensions (see Table 1).

Table 1

Alternative Dichotomies Describing Cognitive Style

| Paradigm Consistent | Paradigm Breaking |
|----------------------------|--------------------------|
| Linear | Nonlinear |
| Incremental | Radical |
| Concrete | Formal |
| Analytic | Holistic |
| Convergent | Divergent |
| Adaptive | Innovative |
| Improve | Create |
| Sensible | Intuitive |
| Transactional | Transformational |

| Paradigm Consistent | Paradigm Breaking |
|---------------------|-------------------|
| Conforming | Original |
| Hedgehog | Fox |

To reduce terminological confusion, we use incremental and radical as polar labels for style, except when referring to particular widely accepted theories. Linear and nonlinear refer specifically to modes of information processing, particularly drawing on their mathematical and psychological foundations for definition (Bratianu & Vasilache, 2009; Thibodeau et al., 2016; see Appendix A). Each pole is treated as an independent mode of processing.

Kirton (1976, p. 623) conceptualised cognitive style through organisational behaviour, distinguishing adaptors (linearity) from innovators (nonlinearity). These concepts were operationalised as behavioural traits, with conformity and efficiency negatively related to originality ($r = -0.41$, $p < .001$), all rooted in the personality domain. Furthermore, a bipolar configuration with a normal distribution shows half of the population limited to adaptive (linear) reasoning, while the other half is concerned with innovation (nonlinear) reasoning.

Tetlock (2005, 2017), drawing on Berlin's (1953) metaphors of the Hedgehog and the Fox, developed a similar bipolar framework. However, subsequent analysis by Meynhardt et al. (2017) indicated that these constructs represent two independent factors ($r = 0.20$, $p < .01$). (See also: Clapp & Ruckthum, 2023; Gilson & Madjar, 2010; Malik et al., 2019)

When considering the issues surrounding bipolarity and independence, Cacioppo et al. (1997) argued that attitudinal constructs are more accurately modelled in bivariate rather than bipolar space. Importantly, attitudes often shift from bivariate to bipolar structures when value-laden beliefs guide behaviour.

Cognition

While behaviours are directly observable, much of our qualitative understanding of cognitive style originates from interpreting these behaviours, evident in the work of Berlin (1953), Clapp and de Ciantis (1989), Kirton (1976), and Tetlock (2005). However, defining cognition requires a conceptual shift: from external behavioural patterns (common to both personality and cognitive research) to the internal, often unobservable mechanisms and mental processes inferred from those patterns. This perspective is foundational to cognitive psychology, which suggests that understanding an individual's interaction with their environment necessitates examining the internal representations and computations that underlie behaviour (Lewin, 1952). Cognitive theories, such as social-cognitive theory (Bandura, 2018) highlight internal constructs like schemas, self-efficacy, and expectations. These frameworks extend psychological analysis beyond observable behaviour, offering a more comprehensive understanding of thought processes and their influence on action.

While many stylistic conceptions of cognition are derived from behavioural outcomes (e.g., Berlin, 1953; Kirton, 1976; Tetlock, 2005), they often rely on dichotomies (sometimes framed as bipolar constructs) to imply mutually exclusive differences in cognitive processing. In contrast, Piaget's (1950) developmental theory offers a hierarchical model of cognitive

growth, introducing distinct stages such as concrete and formal operations. These stages are not merely quantitative increases in capacity but involve qualitatively different modes of thinking with distinct stylistic attributes.

Piaget's framework posits that each stage builds additively on the one before it, incorporating increasingly complex reasoning. The concrete operational stage emphasises reasoning grounded in cultural norms and shared learning experiences, while the formal operational stage enables abstract, individualised reasoning, including nonlinear thought. Concrete cognition is typically linear, whereas formal cognition introduces, in addition, nonlinear and hypothetical reasoning. While Piaget assumed a universal transition to the formal stage, later research questions whether this progression is inevitable or influenced by environmental and individual factors. This challenges the notion that level (extent or complexity) is wholly separable from style (unique mode of expression). In practice, style may shape or constrain the development of level (e.g., artistic minimalism may deliberately resist complexity), while progression to higher levels may require stylistic change, as seen in the abstract reasoning demands of formal operations.

Concrete Cognition

Concrete cognition is characterised by linear, cause-and-effect reasoning grounded in shared cultural practices and direct experience. Individuals at this stage apply logic to tangible, observable phenomena. Foundational cognitive skills, such as counting, language comprehension, and understanding of physical causality, emerge early and are reinforced through consistent sensory feedback. For instance, the association between touching a hot surface and experiencing pain forms a predictable, linear learning pattern (Bratianu & Vasilache, 2009) a habitual mode of information processing.

In social and institutional contexts, many aspects of life are structured through rule-based systems that reinforce linear reasoning (e.g., “if X, then Y”), including legal statutes, democratic procedures, and scientific methods (Bratianu & Vasilache, 2009). As such, the concrete operational stage supports practical, rule-based problem-solving but remains limited to scenarios that can be directly perceived or experienced. Logic is applied effectively, but only within the bounds of tangible objects and information. (See Appendix A)

Formal Cognition

The formal operational stage builds on the logical structures of concrete cognition, introducing the capacity for abstract, hypothetical, and systemic reasoning. While the cognitive tools of the concrete stage remain intact, formal cognition adds flexibility, enabling individuals to reason about concepts beyond direct experience, such as freedom, justice, future scenarios and scientific models. Typically emerging around age 11 and continuing into adulthood, formal cognition allows for hypothetical thinking, future planning, and metacognition, (reflective awareness of one's own thinking). This stage represents a qualitative shift, facilitating multi-perspective reasoning and engagement with abstract systems. Importantly, formal cognition does not replace concrete cognition but expands upon it. Individuals who reach this stage can operate across both domains, applying linear logic when appropriate and nonlinear or abstract reasoning when needed.

The stylistic distinctions associated with formal cognition are not always adequately captured by dichotomous, mutually exclusive models that encourage the existence of a preference. While the concrete stage involves relatively uniform and widely shared cognitive tools, the formal stage reveals additively substantial individual development and use of abstract reasoning. Within this additive model, both linear and nonlinear processes are co-present for the generation and selection of solutions. Individuals may show a preference for a particular approach, and those with strong intrinsic motivation are especially likely to gravitate toward nonlinear solutions (Amabile et al., 1994). Thus, distinctions within formal cognition may reflect stylistic differences shaped by motivational orientations, rather than purely developmental ones.

Personality and Stylistic Behaviour

Because thinking precedes both behaviour and outcomes, it is unsurprising that constructs found in cognitive research also appear in personality, particularly in relation to cognitive style (Gelade, 2002; Von Wittich & Antonakis, 2011). Personality emerges early in life, rooted in biologically based temperament. During middle childhood (ages 6-12), consistent behavioural patterns begin to consolidate into identifiable traits, and by adolescence (ages 12-18), these traits typically stabilise and persist into adulthood.

Some research indicates that the origins of the Big Five personality traits are rooted in evolutionary adaptation, encompassing both incremental and radical behavioural tendencies (MacDonald, 1998; McCrae et al., 2000). Applying evolutionary logic, Van der Molen (1994) identified two countervailing tendencies in social species: one favouring cooperation and conformity to promote group cohesion, and another favouring competition for scarce resources essential for survival and reproduction. These divergent behavioural strategies are thought to have distinct biological foundations and may correspond to separate neurochemical systems, most notably serotonin and dopamine (Foxall, 2014; Robbins & Cools, 2014).

Personality as a Style Concept

Personality may be conceptualised as the enduring behavioural strategies individuals employ across contexts, in life, relationships, and problem-solving. However, only a subset of personality traits contributes meaningfully to unique, stylistic patterns of behaviour and their associated outcomes.

Costa and McCrae (1992) argue that the Five-Factor Model (FFM) of personality reflects biologically based dispositions that are, in large part, independent from those shaping cognition. While personality traits influence patterns of thinking, they do not fully account for cognitive abilities such as intelligence or linear reasoning skills. Thus, the linear style may function as a factor, largely separate from personality (Costa & McCrae, 1992).

Among the Big Five traits, openness to experience has received the greatest attention in relation to cognitive style, particularly for its association with nonlinear, exploratory, and transformational thinking. This aligns with the advanced reasoning capabilities associated with Piaget's formal stage. Conversely, the linear dimension of cognition, with content rooted in structure, repetition, and refinement associated with Piaget's concrete stage, has received comparatively little attention.

Costa and McCrae (1992) conceptualise openness as a bipolar dimension. Individuals high in openness tend to be imaginative, intellectually curious, and aesthetically sensitive, while those low in openness are more conventional, routine-oriented, and resistant to novelty. To further analyse the role of openness, two-factor (De Young, 2014) and four-factor (Kaufman, 2013) configurations have been constructed. While offering more insight into the detailed relationships with other variables, the role of openness as a nonlinear style of information processing is only briefly addressed.

While the bipolar dichotomy of openness (a key personality trait) parallels the developmental transition from Piaget's concrete to formal operations, it calls into question whether certain cognitive functions, particularly those central to cognitive style, can be meaningfully separated from personality. This perspective suggests that openness may not merely correlate with, but actually constitute the nonlinear cognitive abilities associated with formal reasoning. Supporting this view, previous research indicates that fewer than 50% of individuals consistently achieve or utilise formal operational reasoning in adulthood (Huitt & Hummel, 2003; Kazi & Galanaki, 2020; D. Kuhn et al., 1977).

Using a completely different experimental method (the evaluation of a measure of linearity), a similar bias towards linearity was found (Bratianu & Vasilache, 2009). These findings imply that openness may be better conceptualised not as a true bipolar construct, but as a unipolar individual difference representing a capability of nonlinear thinking when processing information.

Although openness and conscientiousness are frequently found to be negatively correlated, conscientiousness does not offer a robust stylistic counterpart to openness. Yilmaz (2020) showed that "openness is positively related to radical, but not to incremental creativity. Conscientiousness was not related to either creativity type and did not interact with openness in predicting radical or incremental creativity". Instead of fostering a distinct cognitive style, conscientiousness appears to function primarily as a constraint, often suppressing facets such as fantasy and imaginative thinking (Reiter-Palmon et al., 2009; Roccas et al., 2002). This may reflect a historical bias in personality research, where incremental creativity was underrepresented in the operationalisation of conscientiousness.

Environmental Context and Psychological Climate

Social immersion in culture plays a foundational role in early cognitive development, influencing language acquisition, problem-solving ability, emotional intelligence, and executive functioning (Bandura, 2018). Several key effects are well established in developmental and social-cognitive research:

Social interaction is foundational. Children develop cognitively through engagement with more knowledgeable individuals, such as adults, caregivers, or older peers. Rich social environments enhance memory, attention span, and problem-solving capabilities (Vygotsky, 1997). Furthermore, secure attachments support development. Early bonds with caregivers create a sense of psychological safety, facilitating exploration, learning, and autonomous decision-making. Again, positive social relationships contribute to resilience, self-esteem, and

mental health (Bowlby, 1982).

Conversely, insufficient social immersion, for example, in the contexts of isolation or neglect, can delay language acquisition, impair social cognition, and disrupt emotional regulation, ultimately hindering broader cognitive development.

While early social environments shape foundational development, later immersion in organisational contexts introduces new layers of cultural influence. These environments present distinct supports and constraints, often reflecting broader societal norms while introducing context-specific demands. Several theoretical frameworks have sought to operationalise these influences (e.g., Varnum et al., 2009).

From a socio-cultural standpoint, the independence-interdependence continuum captures how individuals prioritise personal versus relational social identity. Cultural values such as individualism versus collectivism, and motivations such as intrinsic versus extrinsic, all play a part in supporting behavioural expression in social and organisational contexts.

At the organisational level, Cameron and Quinn's (1999) competing values framework delineates two key cultural dimensions: flexibility versus stability, and internal integration versus external differentiation. Cultures that emphasise flexibility and differentiation tend to foster nonlinear thinking. Cultures that emphasise stability and integration support linear thinking, oriented towards improvement and refinement. All are involved in diversity at the organisational level (Drucker, 1969; Kirton, 1976, 2011).

As individuals transition into adolescence and early adulthood, particularly within professional environments, they encounter situational constraints and supports that shape behavioural tendencies. In this context, the concept of psychological climate offers a useful lens. Unlike structural or cultural attributes of organisations (e.g., size, hierarchy, formal policies), psychological climate refers to an individual's subjective perceptions of their environment (Jones & James, 1979; Litwin & Stringer, 1968). It reflects the meanings people construct about the conditions in which they work and live. This interpretive dimension of climate is essential for understanding behaviour. As Kelly (1963) proposed, individuals operate through personal constructs and frameworks that define how they interpret their world. Psychological climate, then, can be understood as a "local worldview", shaping cognitive and behavioural patterns. Schneider's (1975) assertion that "climates are for something" highlights the importance of defining the behavioural domain of interest when assessing climate, such as safety (Zohar, 2014), innovation, or collaboration (Clapp, 1991).

In large, complex organisations, dominant cultural patterns often drift toward linear, structured thinking. These psychological climates tend to prioritise stability, control, and risk minimisation, thereby suppressing nonlinear cognition. In such environments, linear thinking, (doing things better) is more likely to be rewarded than nonlinear thinking (doing things differently) (Drucker, 1969; Kirton, 2011; Shao et al., 2019).

Cognitive Style as a Preference

Cognitive style refers to the consistent ways in which individuals prefer to process information and approach tasks (Zhang & Sternberg, 2006). As an individual difference, cognitive style reflects a tendency either to preserve and refine existing paradigms or to challenge and diverge from them. Crucially, cognitive style is distinct from cognitive capability as it describes how individuals prefer to think, rather than how effectively they think.

From a cognitive perspective, rather than passively recording experiences, individuals actively filter, organise, and assign value to information (Zajonc, 1980). Within this framework, cognitive style reflects the preferential use of different mental processes associated with individual information processing. Primarily, this position has developed from the consideration that the different modes of information processing are mutually exclusive, and an individual will exercise a preference for one or the other modes of processing information.

The issue of cognitive preferences becomes particularly salient during Piaget's formal stage, which introduces the capability to integrate linear reasoning with abstract, hypothetical, and flexible thought additively, rather than as a bipolar configuration. This also marks a departure from the earlier concrete stage, where cognition is restricted to direct and observable experiences. The formal stage affords individuals the capability to choose between linear and nonlinear thought strategies, enabling more adaptive and complex reasoning in response to environmental considerations, i.e., $B = f(I.E)$ (Lewin, 1952). However, not all individuals function within the formal stage. Research suggests that fewer than 50% of adults regularly demonstrate formal reasoning abilities (Huitt & Hummel, 2003; Kazi & Galanaki, 2020; D. Kuhn et al., 1977). (Kirton's dimension of cognitive style is also described as mutually exclusive, where 50% of the population is separated as part of a normal distribution) Consequently, a substantial proportion of adults rely predominantly on concrete, linear modes of thinking.

Furthermore, individuals who propose nonlinear solutions to problems may face challenges in environments that favour linear cognition. This is particularly evident in large organisations, where psychological climates often reward predictability, structure, and incremental improvement (Clapp, 1991). In such settings, those who perceive that the problem is best served by a nonlinear solution may experience frustration with institutional norms, leading to underperformance, communication difficulties, and limited developmental opportunities (Clapp, 1993; Schneider, 1987).

However, individuals who function within the formal stage can demonstrate cognitive flexibility and switch between the linear and nonlinear cognitive modes to align with perceived situational and personal demands. While this adaptability can also be used to enhance organisational fit, it often incurs a cost in terms of cognitive stress and personal efficiency (Amabile et al., 1994; Clapp, 1993).

Cognitive Development, Personality, and Cognitive Choice

Theories of cognitive development proposed by Piaget (1950) and Vygotsky (1997) suggest that the peak of cognitive growth occurs during early childhood and adolescence, when some individuals acquire the capacity to move beyond concrete, linear thinking and engage in more abstract, flexible, nonlinear reasoning associated with formal operations. While Piaget emphasised biological maturation as the primary mechanism driving this transition, he also noted that not all individuals fully attain formal reasoning abilities. Empirical evidence supports this view, showing that fewer than half of adolescents in modern Western societies reach adulthood with consistently developed formal (nonlinear) cognitive capacities (Huitt & Hummel, 2003; Kazi & Galanaki, 2020; D. Kuhn et al., 1977).

According to Piaget, formal cognition integrates both linear and nonlinear components, introducing a dimension of cognitive choice, an individual difference in preferred reasoning style underpinning what has been described as ambidextrous cognition (Burkert & Grossrieder, 2025; Yilmaz, 2020). Yet, if fewer than half of individuals achieve formal cognition, most adults will rely predominantly on linear thinking rooted in concrete operations. For those capable of both modes, linear thinking persists as a stylistic alternative rather than a developmental limitation, shaping reasoning patterns across contexts.

From a personality perspective, the distinction between linear and nonlinear cognitive styles aligns only partially with the Big Five framework. The nonlinear component of formal cognition closely corresponds to openness to experience, encompassing imagination, flexibility, and abstraction. However, openness, sometimes conceived as bipolar (Costa & McCrae, 1992), does not represent the linear content of concrete cognition.

Moreover, conscientiousness correlates negatively with openness (Costa & McCrae, 1992). This trait comprises two broad clusters: proactive achievement (competence, discipline, striving) and inhibitory conformity (order, dutifulness, deliberation) (Roccas et al., 2002). The latter, characterised by behavioural restraint and rule-following, appears to suppress the imaginative, divergent facets of openness (Reiter-Palmon et al., 2009). Thus, conscientiousness may inhibit aspects of nonlinear cognition without directly supporting linear thought. This suggests that linear thinking lies outside of the personality domain.

Consequently, within the Big Five model, nonlinear cognition aligns with openness to experience, whereas no trait explicitly supports concrete cognition. Reinforcement of linear thought instead arises from psychological climate, the subjective interpretation of environmental factors, and cultural norms embedded in educational, professional, and institutional contexts (Bratianu & Vasilache, 2009; Clapp & Ruckthum, 2023; Schneider, 1987). Climates that emphasise structure, predictability, and compliance tend to favour concrete reasoning while constraining exploration of abstract or nonlinear ideas. This systemic bias toward stability often undermines the creative and innovative potential of nonlinear cognition, despite its relevance in complex, innovation-driven settings.

Concrete cognition and its associated linear reasoning represent universal cognitive capabilities accessible to all. For some individuals, reliance on linear thinking reflects developmental limitations; for others, it is a stylistic preference. In contrast, nonlinear cognition

emerges as an individual difference achieved by fewer than half of individuals and aligns with openness to experience. Crucially, cognitive choice, the ability to shift flexibly between linear and nonlinear reasoning, arises only with the development of formal cognition. This flexibility is not merely an individual difference but an outcome of individual development associated with the formal stage. This underscores the importance of both individual and contextual factors in shaping cognitive styles.

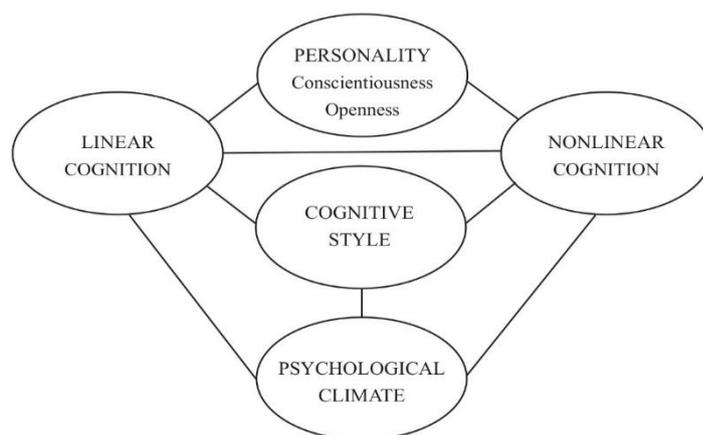
Conceptual

Model

Building on the integration of personality and cognition and preceding the formulation of detailed hypotheses supporting the proposed theoretical position, it is essential to clarify several key relationships. These relationships are depicted in Figure 1. Of particular interest are the associations between linear and nonlinear variables and their interconnections with the other salient constructs.

Figure 1

Theoretical Relationship.



Hypotheses

Hypothesis 1:

The relationship of Linear and Nonlinear cognition with Cognitive Style and Psychological Climate

H1a: The variable associated with linear cognition will show a positive relationship with psychological climate, supporting the view that linear thinking is reinforced by social and organisational culture. Also, linear thinking will be negatively related to the adaption pole of Kirton's measure of cognitive styles, reflecting a preference for established procedures and incremental change. (The adaptive pole is reversed-scored to align with originality)

H1b: The variable associated with nonlinear cognition will show a negative relationship with psychological climate, supporting the view that nonlinear thinking is not reinforced by social and organisational culture. Also, nonlinear thinking will be positively correlated with the originality pole of Kirton's Adaption-Innovation measure, reflecting a preference for radical

change.

Hypothesis 2:

Differentiating linear and nonlinear thinking within cognitive style.

Building on Kirton's (1976, 2011) conceptualisation of cognitive style, scores on the measure can be interpreted relative to its mean. Scores above the mean suggest more innovative tendencies, while scores below reflect more adaptive ones. This distinction provides a framework to examine the universality of concrete cognition versus the uniqueness of formal cognition.

H2a: If concrete cognition is universal, then the variable reflecting linear thinking will not differ significantly between individuals above and below the sample mean.

H2b: In contrast, the variable representing nonlinear cognition will show a significant positive difference among individuals scoring above the mean, indicating that nonlinear cognition is characteristic of a cognitively distinct subgroup.

Hypothesis 3:

Personality Associations of Linear Thinking

H3a: The variable associated with linear thinking will be positively associated with **conscientiousness**, particularly the facets related to order, structure, and rule-following, which are conceptually aligned with linear thinking.

H3b: The variable associated with linear thinking will be negatively associated with **openness to experience** if openness functions as a true bipolar construct, with its low pole reflecting conventional or concrete cognitive tendencies.

Hypothesis 4:

Nonlinear Thinking and Openness

H4: The variable representing nonlinear thinking will show a positive relationship with **openness to experience**, supporting its interpretation as a unipolar construct that reflects creative, abstract, and divergent cognition, rather than the absence of conventionality.

Research Methodology

Experimental Design

This study employed a qualitative reappraisal of cognitive style supported by correlational evaluations to examine the relationship between personality, linear and nonlinear styles, along with psychological climate.

Sample

A convenience sample was drawn from three divisions within the Administrative Services Organisation at the United Kingdom head office of a multinational oil company. The organisation operates with a focus on efficiency and responsiveness, primarily through conventional processes and routine administrative methods.

An invitation outlining the purpose of the study was sent to all 200 employees in the administrative services department. Of these, 153 employees agreed to participate and were

distributed across three independent divisions. Participants received a study description and a questionnaire for self-reporting individual-level data relevant to the research aims.

In addition, a randomly selected subsample ($n = 37$) completed the NEO Personality Inventory (NEO-PI) to assess the Big Five personality traits (Costa & McCrae, 1992).

Research Instruments

Psychological Climate

Psychological climate was conceptualised as individuals' perceptions of organisational and social cultural supports and constraints that influence individual cognitive processing, specifically, those associated with concrete versus formal cognition. Following Lewin (1952) and Kelly (1963), climate reflects an individual's subjective outlook on the broader organisational environment. Along with Schneider's (1975) proposition that "climates are for something," this study focused on dimensions of climate relevant to innovation and change. A 30-item scale was used to measure four climate factors: (1) Support for Change Processes, (2) Opportunity to Contribute to Change, (3) Dynamism, and (4) Support for Idea Generation. Each subscale demonstrated acceptable internal consistency reliability (Cronbach's $\alpha > .70$) and theoretical alignment with change-related processes (Clapp, 1991; Clapp & Ruckthum, 2017).

Cognitive Style

Cognitive style was measured using the Kirton Adaption-Innovation Inventory (Kirton, 1976, 2011), which conceptualises problem-solving style along a theoretical bipolar continuum. The scale includes items that reflect three dimensions: originality, efficiency, and rule/group conformity. For overall scoring, the efficiency and rule/group conformity items are reversed-scored to align with originality. The resulting composite scale shows high internal consistency ($\alpha = .88$, $M = 95.00$, $SD = 17.90$).

In this study, the composite alpha was .87, with a mean of 88.81 (approximately 0.3 standard deviations below the general population mean), indicating a shift toward the adaption pole of the style continuum.

Idea Style

Idea style was assessed through a self-report measure designed to capture individual preferences for either linear (algorithmic) or nonlinear (paradigm-breaking) idea style (Clapp, 1991). As the measures represent the style of ideas and potentially preceded by similar thinking, they are proposed as surrogate measures of linear and nonlinear cognition, where typical items are, respectively, "Improve existing systems with the minimum of disturbance" and "Alter the balance of power and influence."

The measure consists of 14 items, seven representing linear idea characteristics and seven representing nonlinear idea characteristics (Clapp, 1991). Participants rated the characteristics of their own ideas, as generated during creative problem-solving. Factor analysis revealed two distinct but positively correlated factors ($r = .42$, $p = .001$). Both measures have similar characteristics, i.e., theoretical mean (21), reliability (Alpha 0.82, 0.88), standard deviation (5.24, 6.35),

Results and Discussion

Overall Demographics

Table 2 presents the overall demographic characteristics of the sample.

Table 2

Demographic Characteristics of the Sample (N = 153)

| Variable | Percentage/Range |
|----------------|------------------|
| Male | 54% |
| Female | 46% |
| Age Range | 20-58 years |
| Mean Age | 40 years |
| Education | |
| -Baccalaureate | 50% |
| -Advanced | 10% |
| Job Level | |
| -Staff | 66% |
| -Supervisors | 26% |
| -Managers | 8% |

Notably, individuals with further education tend to occupy managerial or supervisory roles. Table 3 displays the overall correlations among the variables.

Table 3

Overall Correlations among the Variables

| | 1 | 2 | 3 | 4 | 5 | 6 |
|--------------------------------|--------|--------|--------|--------|--------|-------|
| 1 Nonlinear Cognition | 1 | .38*** | .39*** | .25** | .44** | -.15 |
| 2 Linear Cognition | .38*** | 1 | .18* | .43*** | .142 | -.35* |
| 3 Cognitive Style | .39*** | .18* | 1 | -.03 | .59*** | .03 |
| 4 Psychological Climate | .25** | .42*** | -.03 | 1 | .29 | -.24 |
| 5 Openness | .44** | .14 | .59*** | .29 | 1 | -.13 |
| 6 Conscientiousness | -.15 | -.36* | .03 | -.24 | -.13 | 1 |

Note: p < 0.05; *. p < 0.01; **. p < 0.001; ***. For variables Openness and Conscientiousness, n=37. For all other variables, n=153.

Hypothesis 1:

The relationship of Linear and Nonlinear cognition with Cognitive Style and Psychological Climate

H1a: The variable associated with linear cognition will show a positive relationship with psychological climate, supporting the view that linear thinking is reinforced by social and organisational culture. Also, linear thinking will be negatively related to the adaptive pole of Kirton’s Adaption-Innovation cognitive styles, reflecting a preference for established

procedures and incremental change. (The adaptive pole is reversed-scored to align with originality).

Table 4

Partial Correlations (Controlling for Nonlinear Cognition) (n=153)

| Variable Pair | Correlation | Significance |
|--|-------------|--------------|
| Linear Cognition ↔ Psychological Climate | .37 | .000 |
| Linear Cognition ↔ Cognitive Style | .03 | .67 |
| Cognitive Style ↔ Psychological Climate | -.14 | .08 |

Interpretation

Controlling for nonlinear thinking, the significant positive correlation between linear thinking and psychological climate supports part of Hypothesis 1a (see Table 4). However, no significant relationship is found between linear thinking and Kirton's cognitive style. This may reflect limitations in Kirton's measure, where factors conformity and efficiency lean toward personality rather than cognition. This point is also supported by the lack of a significant relationship between Kirton's cognitive style and the culturally based measure of psychological climate.

H1b: The variable associated with nonlinear cognition will lack a significant relationship with psychological climate, supporting the view that nonlinear thinking is not reinforced by social and organisational culture. Also, nonlinear thinking will be positively correlated with the originality pole of Kirton's cognitive style, reflecting a preference for radical change.

Table 5

Partial Correlations (Controlling for Linear Cognition) (n=153)

| Variable Pair | Correlation | Significance |
|---|-------------|--------------|
| Nonlinear Cognition ↔ Psychological Climate | .10 | .22 |
| Nonlinear Cognition ↔ Cognitive Style | .35 | .00 |
| Cognitive Style ↔ Psychological Climate | -.12 | .15 |

Interpretation

Controlling for linear thinking, both relationships of the hypothesis, shown in Table 5, are upheld.

Hypothesis 2:

Differentiating linear and nonlinear thinking within cognitive style

Building on Kirton's (1976, 2011) conceptualisation of cognitive style, scores can be interpreted relative to the sample mean. Scores above the mean suggest more innovative tendencies, while scores below reflect more adaptive ones. This bipolar distinction provides a

framework to examine the universality of concrete cognition versus the uniqueness of formal cognition.

H2a: If concrete cognition is universal, then the variable reflecting linear cognition will not differ significantly between individuals above and below the sample mean.

H2b: In contrast, the variable representing nonlinear cognition will show a significant positive difference between individuals scoring above and below the mean, indicating that nonlinear cognition is characteristic of a cognitively distinct subgroup.

Table 6

Independent Samples T-Tests (n=153)

| Variable | T | Degrees of Freedom | Significance (2-tailed) | Mean | 95% CI | |
|----------------------------|------|--------------------|-------------------------|------|--------|-------|
| | | | | | Lower | Upper |
| Nonlinear Cognition | 3.18 | 151 | .002 | 2.62 | 0.99 | 4.25 |
| Linear Cognition | 1.09 | 151 | .280 | 1.12 | -0.91 | 3.15 |

Interpretation

As predicted (see Table 6), linear cognition shows no significant difference across the style difference boundary, confirming Hypothesis 2a. In contrast, nonlinear cognition shows a significant difference, supporting Hypothesis 2b. This distinction supports Piaget’s developmental model, where the unique aspects of formal cognition emerge as an individual difference beyond that of concrete cognition, a potential level concept.

To test for a bias toward either the linear or nonlinear mode of information processing, a paired-sample *t*-test was used to assess the statistical significance of the differences in the means of nonlinear and linear cognition.

Table 7

Study Sample Characteristics (n=153)

| Variable | Mean | Std Deviation | Std Error of the Means |
|----------------------------|-------|---------------|------------------------|
| Nonlinear Cognition | 14.56 | 5.24 | .42 |
| Linear Cognition | 21.11 | 6.35 | .51 |

Table 8

Paired Sample T-Tests (n=153)

| Variable | T | Degrees of Freedom | Significance (2-tailed) | Mean | 98% CI | |
|---------------------------------------|-------|--------------------|-------------------------|------|--------|-------|
| | | | | | Lower | Upper |
| Linear and Nonlinear Cognition | 12.45 | 152 | .000 | 6.49 | 5.31 | 7.78 |

Interpretation

The results in Tables 7 and 8 indicate for this sample a significant bias toward the linear mode of information processing, supporting previous findings by Huitt and Hummel (2003), Kazi and Galanaki (2020), and D. Kuhn et al. (1977), as well as those of Bratianu and Vasilache (2009). Furthermore, as nonlinear processing appears to be associated with the personality trait of openness, these findings question the potential for cognitive flexibility improvement after personality traits have largely solidified in early adolescence (Watts, 1985).

Hypothesis

Personality Associations of Linear Cognition.

H3a: The variable associated with linear cognition will be positively associated with **conscientiousness**, particularly the facets related to order, structure, and rule-following, which are conceptually aligned with linear thinking.

H3b: The variable associated with linear thinking will be negatively associated with **openness to experience** if openness functions as a true bipolar construct, with its low pole reflecting conventional or concrete cognitive tendencies.

Table 9

Partial Correlations (Controlling for Nonlinear Cognition) (n=37)

| Variable Pair | Correlation | Significance |
|--------------------------------------|-------------|--------------|
| Linear Cognition ↔ Conscientiousness | -.33 | .03 |
| Linear Cognition ↔ Openness | .01 | .95 |

Interpretation

Contrary to Hypothesis 3a, linear cognition shows a negative relationship with conscientiousness, though only marginally significant, see Table 9. This relationship appears limited to the competence facet, associated with self-esteem and locus of control. Hypothesis 3b is also not supported, as no significant relationship is found between linear cognition and openness. These results question the validity of openness as a bipolar construct and suggest that linearity aligns more with cultural and extrinsically motivated behaviours.

Hypothesis 3 is rejected. These findings suggest that conscientiousness does not align with the concepts embedded in linear cognition and that Openness can be more accurately described as unipolar. (see also Yilmaz, 2020)

Hypothesis

4

Nonlinear Cognition and Openness.

H4: The variable nonlinear cognition will show a positive relationship with openness to experience, supporting its interpretation as a unipolar construct that reflects creative, abstract, and divergent cognition, rather than the absence of conventionality.

Table 10*Partial Correlations (Controlling for **Linear Cognition**) (n=37)*

| Variable Pair | Correlation | Significance |
|--|-------------|--------------|
| Nonlinear Cognition ↔ Openness | .42 | .01 |
| Nonlinear Cognition ↔ Conscientiousness | -.05 | .76 |

Interpretation

Controlling for linear cognition (see Table 10), a significant positive relationship is found between nonlinear cognition and openness, confirming Hypothesis 4. The lack of a negative correlation with conscientiousness adds weight to the argument that openness is best conceptualised as a unipolar construct. These findings support the notion that openness (a personality trait) reflects the individual cognitive skills aligned with Piaget's formal stage, skills absent in some adult populations (Kazi & Galanaki, 2020; D. Kuhn et al., 1977). Hypothesis 4 is supported.

Discussion

This study bridges cognitive development and personality by reconceptualising cognitive style as two independent modes of information processing: linear and nonlinear. Drawing on Piaget's developmental framework, the findings suggest that the concrete and formal stages are not simply sequential maturational phases but qualitatively distinct modes of cognition. Concrete cognition emerges as a linear, socially reinforced capability. Formal cognition, by contrast, integrates linear processes with a nonlinear individual difference strongly associated with the personality trait of openness. Isolating the unique contribution from each stage forms two modes of information processing, respectively, linear and nonlinear

The results reinforce the view that linear cognition is not an individual difference situated within the personality domain but a culturally reinforced cognitive capability. In contrast, nonlinear cognition represents an individual difference aligned with openness, indicating that the formal stage depends on both developmental and dispositional factors. This challenges traditional models of cognitive style, which are defined by a single bipolar continuum. Instead, the evidence supports a dual-mode framework in which linear and nonlinear cognition operate independently and additively.

This dual-mode model explains why individuals who reach the formal stage display ambidexterity, greater style flexibility, drawing on both modes of information processing depending on motivation, preference, and context. Conversely, those with less flexibility remain confined to linear thinking, whether due to personal developmental limitations or contextual reinforcement.

A significant finding is the continuity of concrete cognition regardless of developmental stage. This suggests that linear cognition is a foundational capability shaped primarily by external influences rather than by personality. By contrast, the distinctive features of formal

cognition are tied to personality, where openness, a focal individual difference, signals a developmental transition.

The two modes of information processing also underpin different forms of creativity. Linear thinking supports incremental creativity, anomaly correction, and improvement all within established paradigms, whereas nonlinear thinking facilitates paradigm-shifting perspectives, radical creativity, and innovation. In this sense, cognitive style emerges as a developmental construct influenced by personality. Some individuals prefer to refine existing frameworks, while others, capable of switching between modes, demonstrate cognitive ambidexterity (Yilmaz, 2020), adapting their thinking in response to situational or motivational demands.

These insights extend to broader typologies of thinking, problem-solving, and leadership. For example, in Berlin's metaphor of the hedgehog and the fox, formally developed thinkers (foxes) can act like hedgehogs, but concrete thinkers (hedgehogs) lack access to the mechanisms that enable fox-like flexibility. Similarly, in a re-conception of Kirton's adaptor-innovator model, innovators may adopt adaptive behaviours, but adaptors are not able to behave as innovators.

In the context of leadership, these cognitive styles help reframe organisational effectiveness. Rather than treating transformational and transactional leadership as opposites, this study suggests that effective leaders integrate both styles, enabled by the cognitive flexibility that accompanies formal development. By contrast, leaders limited to concrete cognition may struggle to enact transformational change.

These findings challenge deeply held views of cognitive style as a bipolar construct. Instead, they support a developmental model in which linear thinking provides a universal cognitive function, while nonlinear thinking represents a personality-linked individual difference. Recognising these as independent, additive modes of information processing clarifies why some individuals exhibit versatile, dual-mode cognition, while others remain committed to stable, incremental approaches.

Conclusion

This study reconceptualises cognitive style as two independent modes of information processing, linear and nonlinear, grounded in Piaget's theory of cognitive development. The findings indicate the following:

Concrete cognition is grounded in linear thinking, universally accessible, and shaped by social and organisational contexts, while formal cognition introduces a nonlinear mode of thinking that is closely associated with the personality trait of openness.

Unlike linear cognition, nonlinear cognition is not universally available and, due to its relationship with personality, appears less malleable once personality traits solidify in early adolescence (Watts, 1985).

These results challenge traditional bipolar models of cognitive style and instead support an independent, dual-mode framework. Individuals who remain at the concrete stage may be

confined to linear strategies, whether through limited personal developmental progression or external constraints. By contrast, individuals at the formal stage demonstrate cognitive ambidexterity: they can engage both linear and nonlinear cognition while flexibly recognising situational and motivational demands and exercising preference.

The dual-mode framework offers broad applicability:

- **Leadership:** Transformational leaders draw on both cognitive modes, whereas transactional leaders may depend predominantly on linear thinking.
- **Thinking typologies:** In the production of solutions, different styles of ideas are used when problem-solving.
- **Decision Making:** considering the stylised fit to the organisational environment.
- **Recruitment:** balancing consideration of the individual fit with organisational culture and the needs of diversity.

In total, this study proposes that linear cognition represents a universal, environmentally shaped mode of thought, while nonlinear cognition constitutes a distinct, personality-based trait. Recognising these as additive rather than bipolar systems enriches our understanding of how people think, lead, and create, both incrementally and radically.

Suggestions for Further Research

This study highlights the need to explore:

1. The roots of linear cognition and its relationship with intelligence
2. The developmental transitions from concrete to formal cognition.
3. Within an organisation, the definition of individual ambidexterity and its relationship with diversity.
4. The definitions of level and style. Is style an inherent bipolar contrast or can it be represented by contrasting independent constructs as modes of information processing?

Such research could deepen our understanding of the interplay between cognitive development and personality in shaping thinking styles, styles of creativity, and leadership effectiveness.

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